इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 13410 (1992): Glass reinforced polyester sheet moulding compounds (SMC) [PCD 12: Plastics]

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 13410 : 1992
(Reaffirmed 2003)

भारतीय मानक

काँच प्रनलित पालिएस्टर चद्दर – विशिष्टि

Indian Standard

GLASS REINFORCED POLYESTER SHEET MOULDING COMPOUNDS (SMC) — SPECIFICATION

UDC 678·674·046·364

© BIS 1992

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 1992 **Price Group 2**

Plastics Sectional Committee, PCD 12

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Although phenolic and amino moulding powders remains by far the most common of the thermosetting moulding compositions, a number of new materials have been introduced based on polyesters, epoxides and silicone resins. Five classes of polyester compounds may be recognized:

a) Dough Moulding Compounds (DMC), also known as Bulk Moulding Compound (BMC);

b) Sheet Moulding Compounds (SMC);

c) Alkyd Moulding Compositions sometimes referred to as "Polyester alkyds";

d) Diallyl Phthalate Compounds; and

e) Diallyl Iso-phthalate Compounds.

Glass reinforced polyester moulding compounds have in general a high mechanical strength and also good electrical insulation and arc resistance. These are suitable for many engineering applications.

The dough moulding compounds (DMC) were originally developed in an attempt to combine the mechanical properties of polyester-glass laminates with the speed of cure of conventional moulding powders. In spite of their somewhat high cost they have now established themselves in a number of applications where a mechanically strong electrical insulant is required.

Manufacturing of traditional dough moulding compounds also involves intensive shear and hence extensive damage to fibres so that strengths obtained with GRP—laminates are seldom realized. This problem is largely avoided with the 'Sheet Moulding Compound' (SMC), which were introduced in about 1967. Resin, lubricant, filler, thickening agents and curing systems are blended together and then coated on to two polyethylene films. Chopped glass rovings are then fed between the resin layers which are subsequently sandwiched together and compacted. For mouldings, blanks may easily be cut to the appropriate weight and shape.

This Indian Standard is first in the series on Specification for Glass Reinforced Polyester Mouldings. Dough Moulding Compounds is also under preparation.

In this standard, three grades of sheet moulding compounds are covered and which are further distinguished according to their electrical and mechanical properties.

Characteristics given in Table 3 are optional and are subject to agreement between the purchaser and the supplier.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GLASS REINFORCED POLYESTER SHEET MOULDING COMPOUNDS (SMC) — SPECIFICATION

1 SCOPE

1.1 This standard specifies requirements for thermosetting polyester sheet moulding compounds which are classified according to their electrical and mechanical properties and which are used for processing by compression moulding.

1.2 Compounds whose fibrous reinforcement include glass, other than E-glass, are excluded in this standard.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this Indian Standard:

IS No.	*Title*
2824 : 1975	Method for determining comparative tracking index of solid insulating materials under moist conditions (*first revision*)
2828 : 1964	Glossary of terms used in the plastic industry
3396 : 1975	Methods of test for volume and surface resistivities of solid electrical insulating materials (*first revision*)
4486 : 1967	Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials, at power, audio and radio frequencies including wavelengths
4905 : 1968	Methods for random sampling
6746 : 1972	Unsaturated polyester resin systems for low pressure fibre reinforced plastics
8504 (Part 1) : 1977	Guide for determination of thermal endurance properties of electrial insulating materials: Part 1 Temperature indices and thermal endurance profiles
(Part 2) : 1983	Part 2 List of materials and available tests
8543 (Part 1/Sec 2) : 1979	Methods of testing plastics: Part 1 Characterization of polymer structure and size, Sec 2 Determination of density of solid plastics
(Part 4/Sec 1) : 1984	Part 4 Short term mechanical properties, Section 1 Determination of tensile properties
11273 : 1992	Woven roving fabrics of 'E' glass fibre
11320 : 1985	Glass fibre rovings for the reinforcement of polyester and of epoxide resin systems
11551 : 1986	Glass fibre chopped strand mat for the reinforcement of polyester resin systems
13360 (Part 1) : 1992	Plastics — Methods of testing: Part 1 Introduction
(Part 6/Sec 6) : 1992	Part 6 Thermal properties, Section 6 Determination of flammability by oxygen index
13411 : 1992	Glass reinforced dough moulding compounds (DMC)

3 TERMINOLOGY

3.1 For the purpose of this standard, the definitions given in IS 2828 : 1964 and the following shall apply.

3.1.1 *Batch*

A quantity of material so designated by the supplier and substantially uniform in quality.

3.1.2 *Glass*

Low alkali E-glass containing not more than 1 percent alkali metal oxides expressed as Na_2O as prescribed in IS 11273 : 1985 and IS 11551 : 1986.

3.1.3 *Type Tests*

Tests carried out to prove conformity with the specifications. These are intended to prove the general qualities and raw materials of a given type of Sheet moulding compound (SMC).

3.1.4 *Acceptance Tests*

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.1.5 *Routine Tests*

Tests carried out at manufacturer's works on Sheet moulding compound (SMC) to check the requirements which are likely to vary during production.

4 GRADES

4.1 The thermosetting polyester sheet moulding compounds shall be of the following grades:

S_1 — General Purpose Grade,

S_2 — Mechanical Grade, and

S_3 — Electrical Grade.

4.1.1 *Special Grades for Specific Requirements*

Improved chemical, thermal, electrical, mechanical, low shrink or flame retardant properties may be derived from the above grades. Such grades shall be designated with suffix "S" along with the description of the special properties as given below:

S_2S — Modified mechanical grade with superior electrical properties

5 COMPOSITION

The material shall consist essentially of an unsaturated polyester resin system, combined with fillers and fibrous reinforcement to form a mix which is pliable at room temperature and is capable of being cured by moulding under heat and pressure. The reinforcement shall be glass fibre made out of E-glass. The unsaturated polyester resin system shall be generally as per IS 6746 : 1972.

6 REQUIREMENTS

6.1 Colour

The colour of the polyester moulding compound shall be as agreed by the purchaser and the supplier.

6.2 Form

The moulding compound shall be in sheet form sandwiched between two layers of polyethylene sheets.

6.3 Mass per Unit Area

Mass per unit (kg/m^2) area of the sheet shall be as agreed to between the purchaser and the supplier.

6.4 Processability

The material shall be suitable for processing by compression moulding. In general following shall be the processing parameters:

a) *Temperature* — 120°C to 160°C,

b) *Curing Time* — 40 to 60 seconds/mm thickness, and

c) *Pressure* — 3 to 20 MPa.

6.5 The requirement for uniformity of a particular type of material presupposes that:

a) the requirements according to Table 1, Table 2 and those given in Table 3 (covered in agreement between the purchaser and the supplier) are fulfilled; and

b) the processing characteristics in the same mould, in same machine and under the same processing condition are presumed identical.

6.5.1 The material characteristics in the moulding, namely the properties of the moulded material, depend on the type of moulding material, the production conditions during moulding, the flow of the moulding material and the connected internal structure in the moulding.

NOTE — The information on the properties of specimen made from moulding materials gives an indication of the properties of moulding which are similar to the specimens.

6.6 When tested by the appropriate methods, the moulded and conditioned material shall comply with the requirements specified in Tables 1 and 2.

NOTE — *See* Table 3 for optional requirements that are subject to agreement and which a purchaser may wish to specify.

6.7 Resistance to Chemicals

The tests for resistance to chemicals and resistance to outdoor exposure are not included as standard tests. These may be covered under optional requirements as agreed to between the purchaser and the supplier as given in Table 3.

6.8 Thermal Endurance

The endurance behaviour of plastics is susceptible to variations with temperature. Determination of a thermal rating corresponding to an extrapolated life of 20 000 hours as specified in IS 8504 (Part 1) : 1977 and IS 8504 (Part 2) : 1983 has to be carried out by a series of tests and is intended to be a guideline for use as insulating material.

Till the industry is able to give the values for thermal rating as an alternative, the maximum continuous operating temperature is specified under optional properties in Table 3.

6.9 Storage Life

The supplier shall state the storage life of the material in the original unopened container under the conditions recommended by the supplier. Immediately after the first opening of the container, at any time within the stated expiry date [**9.1** (f)] the material shall be mouldable and shall comply with the requirements stated in **6**.

7 TESTS

7.1 The requirements have been classified as per type test, acceptance test and routine test.

Table 1 Material Requirements for Sheet Moulding Compound

(*Clauses* 6.5 *and* 6.6)

Sl No.	Characteristic	Requirement			Type of Test	Method of Test, Ref to IS 13411 : 1992
		Grade S_1	Grade S_2	Grads S_3		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Glass content, percent by mass, *Min*	20	25	20	Type	Annex A
ii)	Flow, mm, *Min*		←——170——→		Acceptance	Annex C
iii)	Mould shrinkage, linear percent, *Max*		←——0·25——→		Acceptance	Annex B

Table 2 Requirements for Moulded Sheet Moulding Compound

(*Clauses* 6.5 *and* 6.6)

Sl No.	Characteristic	Requirement			Type of Test	Method of Test, Ref to
		Grade S_1	Grade S_2	Grade S_3		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Density of moulding, g/ml		←——1·8 to 2·1——→		Routine	IS 8543 (Part 1/Sec 2) : 1970
ii)	Water absorption, percent, *Max*	0·25	0·25	0·20	Type	Annex D of IS 13411 : 1992
iii)	Post shrinkage, percent, *Max*		←——0·01——→		Acceptance	Annex B of IS 13411 : 1992
iv)	Izod impact strength, (Notched), KJ/m², *Min*	45	100	55	Type Acceptance for S_2)	Annex E of IS 13411 : 1992
v)	Tensile strength, MPa, *Min*	50	90	70	(Acceptance for S_2 & S_3)	IS 8543 (Part 4/Sec 1) : 1984
vi)	Flexural strength, MPa, *Min*	155	235	170	Type	Annex F of IS 13411 : 1992
vii)	Modulus of elasticity, 10^3 MPa		←—— 12 to 15 ——→		do	IS 8543 (Part 4/Sec 1) : 1984
viii)	Surface resistivity (24 h in water), ohm, *Min*	1×10^{11}	1×10^{11}	1×10^{13}	Routine	IS 3396 : 1979
ix)	Volume resistivity, ohm-cm, *Min*	1×10^{13}	1×10^{13}	1×10^{14}	do	IS 3396 : 1979
x)	Tracking resistance CTI, *Min*	600	600	1 000	Type	IS 2824 : 1975
xi)	Power arc resistance, sec, *Min*	120	140	180	Type (Acceptance for S_3)	Annex G of IS 13411 : 1992
xii)	Dielectric strength at 90°C in oil kV/mm	9	9	11	Type	IS 6262 : 1971
xiii)	Dissipation factor (4 days at 80 percent RH and at 1 KHz)	—	0·03	0·01	do	IS 4486 : 1967
xiv)	Heat distortion temperature, °C, *Min*	125	150	150	do	Annex H of IS 13411 : 1992
xv)	Oxygen index, percent, *Min*	23	23	24	do	IS 13360 (Part 6/Sec 6) : 1992

Table 3 Optional Requirements for Moulded Sheet Moulding Compounds

(*Clauses* 6.5, 6.7 *and* 6.8)

Sl No.	Characteristic	Requirement			Method of Test, Ref to
		Grade S_1	Grade S_2	Grade S_3	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Continuous use temperature (long term), °C, *Max*	120	130	130	—
ii)	Resistance to chemicals		←——valves to be agreed——→ between the purchaser and the supplier		Annex J of IS 13411 : 1992
iii)	*Coefficient of linear expansion (Thermal), cm/cm/c°, *Min*		←—— 20×10^{-6} ——→		Annex K of IS 13411 : 1992
	*For guidance only				

7.2 The routine test and acceptance tests shall be carried out for every batch by the manufacturer.

8 PREPARATION OF TEST SPECIMENS

8.1 Mould to size the test pieces required for the determination of electric strength, water absorption and impact strength. Cut the remaining test pieces from the moulded sheet. Alternatively, cut the impact strength pieces from the moulded sheet. However, in case of dispute, mould the impact strength pieces to size.

8.2 Condition the moulded test pieces for at least 16 h at room temperature of 27 ± 2°C and ambient relative humidity before testing, unless otherwise specified in the test method.

9 PACKING AND MARKING

9.1 Packing

The polyester sheet moulding compound with a net mass by 25 to 50 kg shall be covered in a polyethene bag and wrapped with cellophane lining. The material shall be packed in a suitable container.

NOTE — Packing in metallic drums are prone to cause contamination.

9.2 Marking

9.2.1 The containers of the material shall be legibly marked with indelible ink and with the following information:

a) Indication of the source of manufacture;

b) Recognized trade-mark, if any;

c) Material specification and grade, flow and colour;

d) Batch number;

e) Date of manufacture;

f) Date of expiry under the conditions specified by the supplier (which shall not be less than 60 days from the date of manufacture); and

g) Net mass

9.2.2 The containers may also be marked with the Standard Mark.

10 SAMPLING

10.1 Lot

All the containers of glass reinforced polyester sheet moulding compounds of the same grade, produced under same conditions of manufacture shall constitute a lot.

10.1.1 Each lot shall be tested separately for the various requirements of the specification. The number of containers to be selected from each lot for this purpose shall be given in Table 4.

Table 4 Scale of Sampling

Lot Size (No. of Containers)	No. of Containers to be Selected in a Sample
(1)	(2)
Up to 100	5
101 - 150	8
151 - 300	13
301 - 500	20
501 - 1 000	32
1 001 and above	50

The containers shall be selected at random from each lot. For this purpose reference may be made to IS 4905 : 1968.

10.2 Number of Tests

From each container selected in the sample, the number of test specimens shall be cut from different portions. The number of test specimens shall be sufficient to carry out all the acceptance and routine tests as given in Tables 1, 2 and 3. The sheets shall also be tested for the thermal endurance as per **6.8**.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard coveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continusly checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference :

Doc : No PCD 12 (750)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices:	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 84 99, 37 85 61, 37 86 26, 37 86 62
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43, 53 16 40, 53 23 84
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16, 235 04 42, 235 15 19, 235 23 15
Western : Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	632 92 95, 632 78 58, 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. PATNA. SRINAGAR. THIRUVANANTHAPURAM

Printed at Printrade, New Delhi, India